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Management of riparian woodlands for control of Pierce's disease in coastal California

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EXECUTIVE SUMMARY

This is a continuing project to develop methods to prevent the spread of Pierce's disease (PD) of grapevines by managing riparian habitats to reduce the presence of the principal insect vector of PD, the blue-green sharpshooter (BGSS). Our goal is to devise methods to reduce populations of BGSS by replacing plants such as wild grape, blackberry, and others used by BGSS for breeding with native plants that are not favored by the BGSS for reproduction or feeding but can improve the environmental impacts of riparian zones. Our tests of buffer strip plantings of redwood and Douglas fir between vineyards and riparian woodlands as a barrier to reduce the influx of BGSS into vineyards during spring have thus far been disappointing because of the long times required to generate buffer plants of a suitable size. Our second goal is to reduce the percentage of BGSSs that are infective with the Pierce's disease bacterium (*Xylella fastidiosa*) by replacing plants that support the multiplication, within-plant movements, and year-round survival of *X. fastidiosa* with plants that do not. Over the past year (1997), we continued to record extremely encouraging results with the riparian removal and replanting treatment. Sticky trap catches of BGSS were reduced over 99% in the treatment in which vegetation was removed and replanted at our first site. At our second site (Napa River), where vegetation was first removed beginning in the growing season of 1996, we found that BGSS counts were reduced by over 70%, but most of the catches in the treated site were at one trap location, located near hillside vegetation that connected to the riparian zone. We continued to establish pretreatment (baseline) at a third site on Maacamas Creek in Sonoma County and began vegetation removal in late 1997.

RESULTS and DISCUSSION

Objective 1. Manipulate the structure and composition of riparian woodlands bordering typical coastal streams adjacent to commercial vineyards by selective plant removal and re-planting of tree and shrub species to reduce breeding of the blue-green sharpshooter, its infectivity with the bacterium *Xylella fastidiosa*, and its dispersal to adjacent vineyards.

In general, the results for removal and replanting at the Conn Creek site continued to meet our expectations for the project. Data on the growth of new hardwood seedlings at the Conn Creek site is summarized in Appendix 1. The growth and survival of Douglas fir planted as a buffer has been disappointing. Poor growth of Douglas fir seedlings continued over the last year. Douglas fir growth was hampered by a dry spring in 1997, but even more by excessive competition from shading of established trees and competition with blackberries and annual weeds.

The second replication of vegetation removal and replacement in the Napa valley was not planted with native tree seed in the spring of 1997 due to inadequate soil moisture subsequent to late winter weed control and debris removal after the January flood. All tree seed collected in 1996 was sown in nursery beds to produce 5500 seedlings of nine native hardwoods for planting in early 1997 on the Napa River site and the third replication on Maacamas Creek in Sonoma Co.. Both of these continuous flow streams will have control and treatment sections approximately 310 meters long. The two narrow riparian corridors are similar in the numerous residual native trees that will remain interspersed with the planted seedlings. A major difference is the steep levee

constructed along the Napa River and the different soil types. The assumption is that the narrow woodland zone will permit sufficient light for the planted seedlings to grow and develop to inhibit weed growth and reduce pesticide applications along riparian-vineyard borders. It is not an option to thin the overstory trees to improve residual tree vigor and disease resistance while enlarging plantable openings due to current assumptions of animal and plant preservation and vineyard investment decisions. Trees that are close to toppling over or dead may be removed or managed as a snag for bird habitat where removal of some branches would make them more stable. Already downed trees that promote fish habitat will be aligned with the stream flow to reduce their role in debris dams and bank erosion during flood stages and anchored by cable.

Objective 2: Assess through monitoring the effects of riparian vegetation management on population density and dispersal of the blue-green sharpshooter vector of Pierce's disease and its infectivity with *Xylella fastidiosa*.

The removal of plants from one treatment in the Conn Creek site again dramatically reduced the numbers of BGSS trapped in this plot compared to the control and buffer strip plots and to populations encountered in this plot last year before plant removal began. Only 4 BGSS were found on the 8 traps in this plot during the entire trapping period. In contrast, 548 were trapped from the control plot and 323 from the buffer strip plot (Table 1 in Appendix 2, Appendix 3A). Again this year we were not able to collect any BGSS from this treatment plot on either the east or west bank of the creek. In contrast, 3 persons collected over 100 BGSS from the adjacent control plot in about 30 minutes.

The populations of BGSS encountered in the control and buffer strip plots were similar to each other, as was also the case the previous year. Douglas fir seedlings remained too small to influence BGSS movements. Last year the vineyard area adjacent to the plant removal and replacement plot was fallow and is now being replanted. The remaining adjacent vineyards were removed in 1996-97. Until the new vineyards reach about 3 years of age, we will not have information on the effects of the vegetation management practices on the spread of Pierce's disease into adjacent vineyards. This evaluation will have to be made after the funding period for this project, but we intend to collect the data in future years.

The plots south of Rector Creek on Conn Creek were replanted with redwood and Douglas fir along the southern half of a plot that had been denuded illegally in 1994 and earlier. This plot has not been weeded or resprouts controlled by the participating grower. The relatively small differences in trap catch between the "control" and "buffer" plantings probably reflect the lack of major differences currently between the two types of plots (Appendix 2). Comparisons of trap catches between the adjacent vineyards between the two treatments were confounded by removal of the "buffer" vineyards from the east levee and by the severe grapevine mortality in the control vineyard caused by Pierce's disease.

At the Napa River site, trap catches were reduced about 70% in riparian locations (Appendix 3B), but over half of the catches in the removal/replant treatment were from a single trap at the southeast extremity of the plot. This trap was within 50 meters of invasive periwinkle and Himalayan blackberry growth, which might explain the lessened degree of control in the Napa River site compared to the Conn Creek site with the same management strategy.

At the Maacamas Creek site, catches on the north and south banks were reasonably similar over the season (Appendix 3C). The prospective treatment and control plots at the Maacamas Creek site were also reasonably symmetrical in average trap count (91.4/trap/season in the projected treatment and 70.8/trap/season on the projected control).

Sampling of riparian vegetation by sweep net sampling in 5 dates in 4 locations supplemented our previous 2 years data to assess host plant preferences of the BGSS. Each sample consisted of 25 sweeps; adults and nymphs were counted and recorded separately. Two new host plants were identified: mule fat (*Baccharis salicifolia*) and Brickellbush(*Brickellia californica*). We recovered nymphs and adults from mule fat in Maacamas Creek and also isolated *X. fastidiosa* from plants

with symptoms of leaf scorch. Initial tests in the lab to confirm the fate of the bacterium in mule fat were inconclusive.

To monitor levels of infectivity of BGSS with *X. fastidiosa,* we collected adult BGSS and tested them in 20 groups of 5 or 20 single insects by feeding then on grape for 4 or more days. For the Conn Creek site, 7 of 18 surviving insects transmitted (39%). This is nearly as high as last year's infectivity rate. We again were unable to collect BGS from the vegetation replacement treatment. At the Napa River site natural infectivity was about 32% (much higher than the 5-15% range from 1996, and we were able to collect 11 BGSS from the vegetation removal site, one of which transmitted (9%). At the Maacamas Creek site, our pooled estimates (3 collection dates) were 5.6% infective, about the same as last year. These estimates of natural infectivity of BGSS with *X. fastidiosa* should provide useful epidemiological data, but will not provide data on the effects of vegetation management on natural infectivity because we have great difficulty in collecting BGSS from the treated plots.

Objective #3 Extend findings and information on riparian management and Pierce's disease to grape growers, relevant government agencies, and the public.

This project is funded jointly this year by the this Pest Management Grant, a grant from the University of California IPM program and a grant from the American Vineyard Foundation. The latter agency provided matching funds to research funds raised by the Napa Valley Pierce's Disease Task Force. The principal investigators and most cooperators have attended regular meetings of the Task Force and have discussed progress on this and related research projects and answered questions from growers, other researchers, representatives of the Dept. of Fish and Game, and other government agencies. Increased community involvement and support was encouraged by activities of the Napa Pierce's Disease Task Force, now renamed the North Coast Pierce's Disease Task Force, and by University of California Cooperative Extension workshops and presentations. Presentations of research on Pierce's disease were given in Napa (April 8, June 11, and September 30, 1997), Sonoma Co. (April 2, June 12, September 16) for Pierce's disease workshops organized by UC Cooperative Extension in each county for grape growers and interested members of the public. Persons attending this workshop were shown the experiments in progress at the Conn Creek site. Additional presentations on progress in Pierce's disease research were given at a an IPM Workshop at the U. C. Kearny Agricultural Center on November 12, 1997, at Temecula (special growers meeting on Pierce's disease) on November 11, 1997, a poster display on project results at the Entomological Society of America's national meeting in Nashville, TN on Dec. 15, a panel discussion at the Unified Wine and Grape Symposium in Sacramento on January 21, 1998, and a seminar at U. C. Davis (Dept. of Plant Pathology) on February 3, 1998.

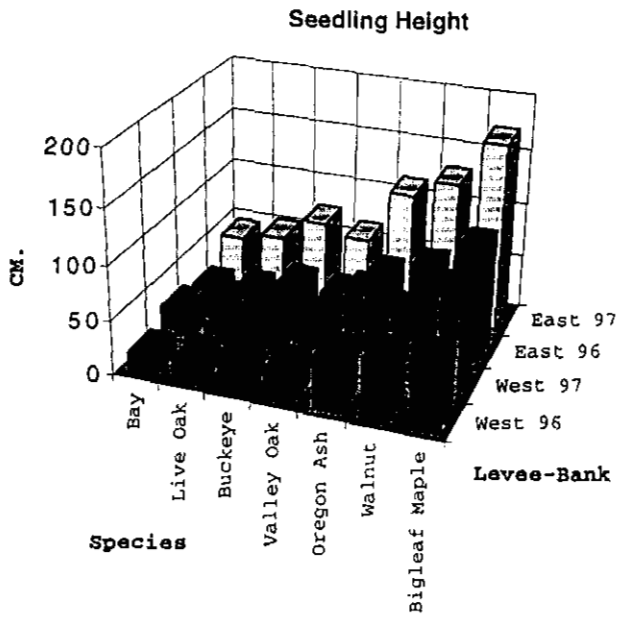
An Internet site (www.cnr.berkeley.edu/xylella) for plant diseases caused by *Xylella fastidiosa* was maintained at U. C. Berkeley as a forum for regional and international information and communication on Xylella-caused crop diseases. Several members of the press and other researchers have commented on the usefulness of this resource. One of the limitations in Xylella-related research is the small number of researchers familiar with this pathogen. The web site is an attempt to bring this group of interested persons in closer contact. The site contains brief overviews of the disease symptoms and distributions of all xylella-caused diseases and of vector transmission, a comprehensive list of relevant published scientific references, lists of expert contacts (with addresses and telephone numbers), and current news items. This year we have included in the Internet site specific guidelines for control of Pierce's disease in the north coast. We hope to add a similar section for central California. We have responded to specific questions on Pierce's disease problems from growers in Napa and Sonoma counties that were prompted from our web site. We anticipate that the number of these requests will increase as more people again access to the Internet and learn that our site is on-line.

Appendix 1A. Growth and survival of the Conn Creek March 1996 planting with ten month old bare root seedlings. The larger growth on the east levee and bank illustrate the competition for light and moisture by the residual overstory that was abundant on the west side. About 75% of mortality occurred because of the 1997 flood.

Seedling Height on Conn Creek Vegetation Management Treatment

	East Conn CR.				**West Conn Cr.**			
Species	No. Planted 1996	Ht. cm. 1996	Ht. cm. 1997	No. in 1997	No. Planted 1996	Ht. cm. 1996	Ht. cm. 1997	No. in 1997
Bay	150	23	45	103	150	18	31	104
Live Oak	100	27	52	69	100	21	31	75
Buckeye	150	40	73	95	150	30	52	116
Valley Oak	250	38	64	194	175	28	38	118
Bigleaf Maple	75	103	171	47	100	61	91	78
Walnut	200	77	129	178	175	55	64	151
Oregon Ash	150	63	113	143	125	49	76	80

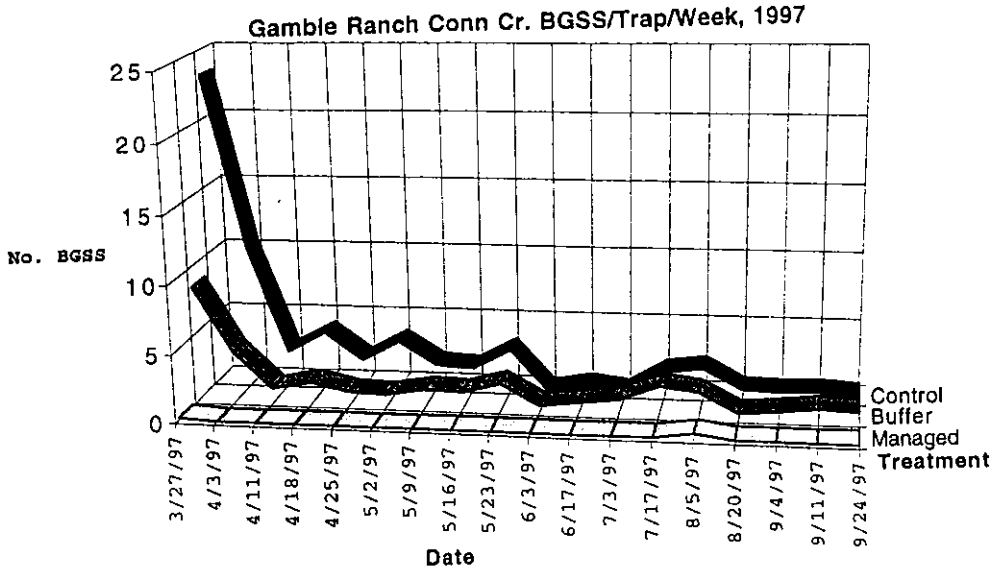
Appendix 1B. Average seedling height at the end of the 1996 and 1997 season showing the differential performance on each levee and bank.



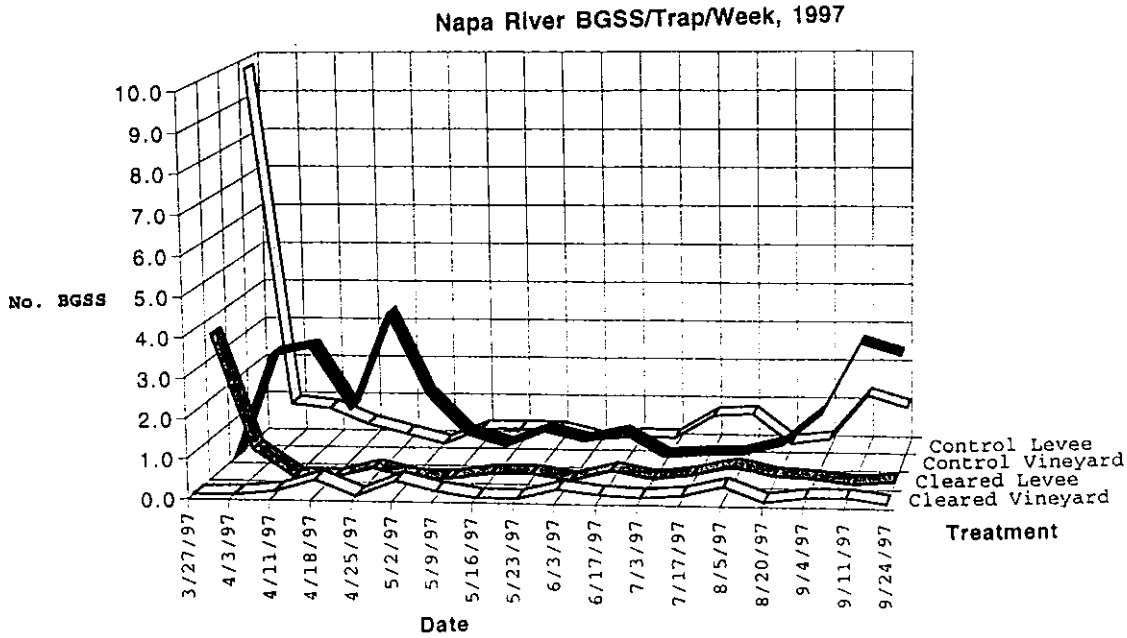
Appendix 2. Summary of total yellow sticky trap catches of the blue-green sharpshooter on three sites in 1997.

Site	Treatment		Total BGSS Number Trapped in 1997		Season Totals
			March-June	July-Sept.	East+West
Conn Creek	East Levee	Clear-Plant	0	3	4
		Control	141	77	548
		Control vineyard	re-plant	re-plant	
North of Rector Creek		Buffer	149	65	323
		Buffer vineyard	re-plant	re-plant	
	West Levee	Clear-Plant	1	0	
		Control	275	55	
		Control vineyard	re-plant	re-plant	
		Buffer	58	51	
		Buffer vineyard	re-plant	re-plant	
	East Levee	Buffer	7	39	57
		Control	28	9	64
South of Rector Creek		Control vineyard	17	1	
	West Levee	Buffer	8	3	
		Buffer vineyard	0	1	
		Control	18	9	
		Control vineyard	7	0	
Napa River	East Levee	North Control	28	30	180
		North vineyard	4	3	19
		South Cleared	25	17	50
		South vineyard	7	5	27
	West Levee	North Control	76	46	
		North vineyard	129	108	
		South Cleared	4	4	
		South vineyard	6	9	
Maacamas Creek	South Levee	to serve as future control	254	229	
	South vineyd		49		
	North Levee	future removal/replant	110	147	
	North vineyd		11	3	

Appendix 3A. Sticky trap catches of blue-green sharpshooter (BGSS) at northern Conn. Creek site, 1997. Data are presented as average trap catch per week per trap with east and west levee catches combined since all vineyards bordering this replication were being replanted from 1997 into 1998. See appendix 2. for summaries of total trap catches.



Appendix 3B. Sticky trap catches of blue-green sharpshooter (BGSS) at the Napa River site in 1997. The data are presented as average trap catch per week per trap with the east and west vineyards and levee catches combined. The control is north of the cleared but not yet replanted treatment.



Appendix 3C. Sticky trap catches of blue-green sharpshooters (BGSS) at the Maacamas Creek site in 1997, which is the second year of trapping in the riparian vegetation prior to any management. The data are presented as average trap catch per week per trap for the north and south sides of the creek. Plant removal on the eastern half of the replication will begin in October 1997.